Workshop Proceedings

Exploring Technologies and Sharing Experiences on Household Water Treatment and Storage (HWTS)

November 29–December 1, 2017

Venue: S M Sehgal Foundation, Gurugram

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Introduction

S M Sehgal Foundation (Sehgal Foundation), in partnership with Save the Children and in knowledge partnership with the Centre for Affordable Water and Sanitation Technology, held a three-day workshop for Water, Sanitation, and Hygiene (WASH) professionals and Indian organizations practicing Household Water Treatment and Storage. This workshop aimed to provide a platform to practitioners to share their experiences, learn from each other and discuss strategies for scaling up.

Rationale

India has the largest number of people in the world without access to safe water (75.8 million), at least 5 percent of the total population.[1] Many more consume contaminated water, which causes the death of more than 140,000 children under age five, each year, due to diarrhoea.

Several stakeholders are working in India to address this challenge and ensure access to safe water. Programs implemented by most of these stakeholders, especially major donors, governments, and international aid agencies, focus on networked water supply systems. Large, networked systems are capital intensive, take years to plan and complete, and are less adaptive and flexible than smaller, non-networked, household or community-level water and sanitation systems. Quickly growing peri-urban slums and rural and remote communities, where the poorest and most vulnerable people often live, are especially hard to reach with centralized networked systems. These communities can be better served by non-networked solutions. This workshop brought together stakeholders and practitioners to support the effective implementation of non-networked water and sanitation solutions in India to reach people who are currently underserved or unserved by traditional networked systems.

[1] UN Joint Monitoring Program Report, 2015.

The World Health Organization (WHO)[2] considers household water treatment and safe storage a viable option for providing safe water to vulnerable households. Knowledge, skill building, networking, and advocacy are needed to promote and scale up HWTS in India.

Sehgal Foundation is one of the few organizations in India that provides in-depth training and technical support on HWTS, with a focus on biosand filters (BSF). CAWST is the only global center of expertise in HWTS. Both organizations work together to fill the need for capacity building on HWTS in India, and the use of biosand filters. The long-term relationship of CAWST and Sehgal Foundation has resulted in more organizations implementing better WASH projects:

- CAWST trained the Sehgal Foundation team on construction and implementation of biosand filters more than a decade ago, and the foundation implemented a biosand filter program.
- Sehgal Foundation teams have received regular support from CAWST and participated in CAWST trainings and surveys.
- In 2015 Sehgal Foundation developed a design for a stainless steel biosand filter with consulting support from CAWST.
- The foundation collaborated with CAWST during 2016–2017 for training other organizations and hosted three CAWST workshops. As a result of these workshops, organizations such as Navjyoti India Foundation, Gurugram; SATHI-Himachal Pradesh; Shramik Bharti, Kanpur, and Prasad Chikitsa, Ganeshpuri (Thane) started implementing stainless biosand filter projects. Organizations such as Shalom Foundation, New Delhi, and Assembly of God, Kolkata, also plan to implement stainless steel biosand filter projects in the future.
- Sehgal Foundation conducted two trainings in 2017 for the capacity building of teams at Navjyoti India Foundation and Prasad Chikitsa on the implementation of the HWTS project.

Sehgal Foundation is currently implementing a project consisting of stainless steel filters and is developing ceramic pot filters. The foundation plans to continue supporting other organizations by providing training and technical support on HWTS and biosand filter topics.

[2] See http://www.who.int/water_sanitation_health/water-quality/household/en/.

3. Objectives

Objectives of this workshop:

1. Exchange success stories and challenges faced by implementers.
2. Identify barriers for quality implementation and discuss how to overcome them.
3. Share updates on new research and development.
4. Discuss ideas for fund-raising for HWTS projects.
5. Motivate organizations to implement HWTS projects across India.

4. Organizations Background and Role

4.1 Host and lead agency: Sehgal Foundation

Sehgal Foundation is a public, charitable trust registered in India since 1999 with a mission is to strengthen community-led development initiatives to achieve positive social, economic, and environmental change across rural India. The foundation envisions every person across rural India empowered to lead a more secure, prosperous, and dignified life. The foundation team works together with rural communities to create sustainable programs for managing water resources, increasing agricultural productivity, and strengthening rural governance. The team's emphasis on gender equality and women's empowerment is driven by the realization that human rights are central to developing every person's potential. Sehgal Foundation works with different national and international partners such as the Ministry of Science and Technology, Government of India, National Bank of Agriculture and Rural Development (NABARD), Coca-Cola Foundation, and Bayer Foundation, among others.

4.2 Partner agency: Save the Children

Save the Children is India's leading independent NGO and child rights organization. Started in 2008 in India, and registered as Bal Raksha Bharat, Save the Children has since changed the lives of more than 6.6 million children. Save the Children works in eighteen states on programs aimed at reducing infant and child mortality, improving children's nutritional status, making quality education accessible, and protecting children from exploitation and abuse. Save the Children works for and with children, for equality, equal education, equal nutrition, equal health, equal opportunities, gender equality, humanitarian situations, and relief during natural disasters. Their pioneering programs address the unique needs of children, giving them a healthy start, the opportunity to learn, and protection from harm.

4.3 Knowledge partner: CAWST

The Centre for Affordable Water and Sanitation is a Canadian charity and licensed professional engineering firm established in 2001. CAWST is a global centre of WASH expertise, providing training and consulting to organizations working directly with the poor in developing countries to meet their basic needs for clean water and sanitation. CAWST works in sixty-three counties around the world, using education to catalyze action, helping people gain the skills they need to access clean water and basic sanitation in their homes and communities.

Workshop Discussions

Day 1

(November 29, 2017)

Mr. Lalit Mohan Sharma director of Adaptive Technologies, Water, at Sehgal Foundation, started the workshop with the question: "Why do we need household water treatment and storage?" He described biological and chemical contamination of drinking water as the biggest challenge in the present context. "In India, most people in rural areas are drinking contaminated water either because there is no treatment system, or systems are defunct due to lack of maintenance. Few state governments have installed treatment systems for fluoride or arsenic, or chlorination plants for disinfection, and *panchayats* who do have responsibility for systems lack the required skills and funds to maintain the systems, as a result of which systems usually become defunct shortly after installation. In some places, *panchayats* have been trying to find solutions for this problem, but success has been largely elusive." Mr. Sharma presented the objectives of the workshop: to identify sustainable and best-possible HWTS and develop strategies for overcoming the challenges pertaining to scaling up of HWTS technologies.

Dr. O. P. Singh, representing Save the Children, briefly presented the work of the organization in the WASH context. He described some practical challenges, especially in rural and urban areas, such as shallow hand pumps used by river basin settlements, which are not safe for drinking purposes, and the need for an impactful demonstration of safe drinking water practices. He said that supplied piped water is considered the safest form of drinking water, but in a country like India the feasibility of the same is questionable due to the cost of the technology and affordability issues. Rural India, he noted, is not open to paying for drinking water as they have always accessed water for free. Dr. Singh ended his presentation with a challenge question: "How can each and every household gain access to safe drinking water in an affordable and sustainable way?"

Mr. Suneel Rajavaram, international technical advisor, CAWST, talked about the history and work of his organization and its vision to make HWTS accessible to everyone. Because only upper and middle-class families can afford household water treatment filters, he explained that CAWST promotes biosand filters and, since 2007, they have promoted ceramic and clay filters. CAWST's main role is to provide technical advice and sharing information on HWTS. To this end, CAWST promotes HWTS technology and provides training and capacity building, develops training materials, and conducts action research, and learning exchanges.

Ms. Arti Manchanda, program leader, Communications, Sehgal Foundation, gave a short introduction about the organization and its vision, highlighting the programs and work at the foundation, including a short video about the first 15 years of the foundation's work. A round of introductions followed this, and organizations present shared informative and interesting experiences.

Mr. Parmod Kumar of Development Alternatives, presented "Purification Technologies Interventions in HWTS." The presentation consisted of a brief introduction of his organization, its work, along with technologies used for HWTS. According to Mr. Kumar, 67 percent of Indian households do not treat their drinking water, even though it has bacteria and chemical contamination. He described the use of portable field-based water testing/monitoring tools, including drinking water quality monitoring kits, digital testing meters for fluoride, total dissolved salts (TDS), and strip/dip testing devices for pH, Nitrate, Nitrite, residual Chlorine, etc.

Mr. Kumar highlighted a list of products available for water treatment:

1) Jal-TARA biosand filters, Aqua+, and Sodis used for bacterial contamination
2) Jal Tara Arsenic, Iron, and Turbidity Filter
3) Jal Tara Fluoride Filter used in cases of chemical contamination

Mr. Kumar and Mr. Lovelesh Dave from IIT, Jodhpur, presented the G Filter, a gravity-based filtration method. The filter is made of 50 percent clay and 50 percent sawdust. A container to store water is made with different material options, such as clay, plastic, and steel. Four G-filters models are available with nine-liter receptacles. The water purification process is comprised of the flow of water over the cross-section of the fired clay-sawdust green composite walls. The process of baking the mixture takes place in a 5X5ft open-hearth furnace. A small discussion took place subsequently on the readiness of the product for the market, testing with high and low TDS, and the filtration rate.

Dr. Dilshad Ahmed, representing Tata Research Development and Design Centre, presented different interventions made for HWTS including Tata Swach Household Filters, Compact Water Purification Cartridge, Arsenic Removal Cartridge, Fluoride Removal Cartridge, ShudhPen Pocket Water Purifier, Funnel Water Purifier, and the TinO Filter. Most meet the WHO and USEPA standards for various contaminations. He added that with continuous research, products keeps changing, specific to the field requirements (like adding more purification capacity to serve large families in rural areas; clay with rice husk ash was added to make Tata Swach more effective).

Dr. Srikant, representing Affordable Water Solutions, presented the Auro Aquasafe: Purifier of Water Sachet developed by Environmental Monitoring Service Laboratory in Auroville, Tamil Nadu. This product is a powdered mixture that removes arsenic, iron, fluoride, pathogenic organisms, and suspended solids, rendering contaminated water into safe drinking water. The product is potable, easy to handle, and highly effective in disaster relief. Auro Aquasafe has an international safety certificate from WQA, USA-NSF/ANCI 60. Dr. Srikant said the challenge faced by his organization pertained to marketing and scaling up of Auro Aquasafe. The price unit of the sachet, three rupees, is borne by Affordable Water Solution. So far there is no significant sale of the product; however they are looking for government support and suitable collaborations with agencies to assist with scaling up.

Mr. Premal Pandya, Tata Chemicals Ltd. described his organization's vision for providing safe and affordable drinking water throughout the year for 25 million people within the next five years. With a range of affordable Tata Swach filters and products like Smart, Cristella Plus, Silver Boost, Desire +, Gravity UF Cartridge Design, and InstaSip Bottle Purifier, Tata Chemicals Ltd. has reached five million households in five years. Continued, efficient service support reduces incidences of waterborne diseases across geographies. The organization has ensured the availability of bulbs/cartridges for all who have bought Tata Swach. The purification capacities range from 1,000–6,000 liters. Technologies used in the above-mentioned products are silver nanotechnology and ultrafiltration (UF). Some technologies are combined such as bulbs powdered with nanosilver technology. Unlike traditional UF, Tata Swach UHF works under gravity in a desktop purifier format and delivers safe potable water without the use of electricity.

To overcome the challenge of supply and delivery in rural areas, a project called *Samriddhi* is primarily focuses on developing new entrepreneurs and enhancing their income through training and capacity buildingto promote safe drinking water with the Tata Swach water purifier in rural India. This dual approach aims to reduce incidences of waterborne diseases and generate income for the rural population. A question that arose post the presentation was regarding the stocking of supply: since ample warehouses are available in rural areas, the group suggested that rural medical shops with safe water products could also be equipped with these products in order to enhance the availability.

Mr. Pandya and Mr. Lalit Sharma from Sehgal Foundation presented JalKalp, an innovative biosand filter model. Mr. Sharma explained that this filter is low-cost and addresses pathogens, iron, arsenic, and turbidity. Jalkalp does not need periodic replacement, has a long life, and is easy to maintain and operate. The stainless steel design makes it lightweight and portable, with an increased filtration rate, and better quality control. Mr. Sharma described some of the features of the filter such as the germicidal properties of copper, which help in pathogen removal, and zerovalent iron technology to treat arsenic, etc. The filter works simply with only five processes: mechanical filtration, adsorption, predation, anaerobic die-off, and safeguarding by copper and arsenic removal by zerovalent iron technology. Screening of two short videos led to better understanding of the functionality and maintenance of the filter. One suggestion was to add a separate tray for removal of silt in order to avoid the use of hands. A second suggestion pertained to the certification of Jalkalp.

A presentation, "Working with people, in Jhabua, affected by Fluoride," was made by Mr. Sachin Vani, associated with INREM Foundation, which earlier conducted environment management studies and now focuses more on water issues. In 2002, during a study on reverse osmosis in Gujarat, the issue of fluoride came up. Mr. Vani explained that despite the latest technologies, people are still drinking water contaminated with fluoride, simply because of high operational and maintenance costs of community-level purification plants. These costs are the main reason for the failure of community-based filters and other technologies. After considering all challenges and factors, INREM Foundation found a solution for providing filters at the household level that are user-friendly and mostly manufactured locally. Technologies used are activated alumina for fluoride and Zero B for bacteria removal. Designs evolved according to the need of the households, such as adding activated carbon to improve the taste of water. To ensure the sustainability of practices, the community was involved in water testing. Through this involvement, the community understands the limitations of their drinking water, and hence motivates them to work toward the improvement of water quality. The foundation is looking for other options for the treatment of community water resources.

Mr. Manish Wasuja from UNICEF drew attention to the safe handling of drinking water and the focus areas of the Government of India:

- Water availability throughout the year
- Two priority chemical contaminants i.e. arsenic and fluoride
- Water free of fecal contamination

The government's target under *Har Ghar Jal* (water in every household) is to ensure that piped water becomes accessible to most people. The main challenge is to ensure water free of fecal contamination, which is only possible with safe water storage and handling. Earlier, the focus was on improved water quality, but the focus has now shifted to safe handling of water. To mitigate the problem, the government has made some changes at the policy level, for example the stoppage of operational and maintenance funds of water. Now the 14th Financial Commission does funding under the condition of community engagement, as this is vital for the safe handling of water. The main point highlighted by Mr. Manish Wasuja was the need to think of a process through which technologies can ensure the safe handling of water.

Dr. Kaira Wagoner, Potters for Peace, made an online video presentation about ceramic filtration units.

Mr. Dharani Saikia from Assam discussed fluoride treatment methods used in households in Assam across two districts, Nagaon and Tapatjuri. After 2003, for fluoride treatment in drinking water, technologies provided included AA filter, Nirmal, and Lime+ Alum. Unfortunately, most of these technologies were a failure because of lack of adoption. Mr. Saikia explained that the gap between demand and supply was the main reason for this; the product did not meet the requirements of the community. Mr. Saikia stressed the need for technology to be sustainable, long-term, fruitful, acceptable, cheap, and easy to use. A household dug well with a hand pump and sand rice husk treatment was selected through a matrix ranking to reduce the fluoride contamination in water. Results are highly remarkable as cases of fluorosis have declined, both with the usage of safe drinking water and a prescribed diet.

At the end of the day, Mr. Suneel Rajavaram, CAWST, conducted an informative session on pathogen types, waterborne diseases caused by them, and their treatment. A session on existing household water treatment technologies followed as he highlighted each step: source protection, sedimentation, filtration, disinfection, and safe storage. The group discussed different techniques, for example settling technique, natural coagulants, and chemical coagulants, and different filters available and their technologies. This session also covered the limitations of each technique, which helps in the further improvement of HWTS practices.

Day 2

(November 30, 2017)

A presentation on “HWTS Technologies” by Dr. Candice Young-Rojanschi, knowledge and research coordinator, CAWST, focused on technology that creates maximum impact. She introduced the 3Cs required to have realized health impact: **C**orrect (effective) technology and use, **C**onsistent use, and **C**ontinued (sustained) use. For any implementer, it is their biggest responsibility to include all 3Cs while designing, implementing, and monitoring a water and health intervention like a water filter. A discussion among group members established that there is no ideal technology; the technology and design is subject to regional context and affordability.

Group Exercise

Possible barriers to 3Cs from the user perspective, and mitigation efforts pertaining to these barriers from an implementer’s perspective, applicable for a low-income household with no access to safe drinking water were listed. Following are some points coming from the group exercise:

Correct		**Consistent**		**Continued**	
Barriers	Mitigation Efforts	Barriers	Mitigation Efforts	Barriers	Mitigation Efforts
Lack of understanding	Proper awareness and demo sessions	Lack of understanding operation and maintenance	Proper awareness and demo sessions	Lack of understanding operation and maintenance	Checklist on handling instructions
Improper maintenance	Regular monitoring by implementer	Lack of supply chain			
Lack of understanding about the correlation of unsafe drinking water with health hazards	Integrated efforts to educate and motivate	Behavioral issues	Positive Behavior Change communication		
Leakage/technical default	Test before distribution				
Same container for treated and untreated water	Separate containers as part of implementation strategy				

Mr. Suneel Rajavaram, CAWST, made a presentation on the use of sand as a filter medium. Of the total organizations participating, seven were implementing biosand filter technology while the other five were willing to implement this technology. Sand forms the core of the biosand filter technology, and this presentation described details pertaining to sand use. BSF is capable of removing helminths, protozoa, bacteria, and some viruses through mechanical trapping, adsorption, predation, and natural die off. BSF requires a few initial months to ripen the biolayer before it becomes fit for use. Therefore, implementers provide chlorine tablets for the initial period.

I. Some important characteristics to consider during the design of good and effective treatment:
   1. Flow rate (higher flow rate/low adsorption), surface area (higher surface area/more adsorption) and pore size.
   2. The maximum grain size is 0.7, which is greater than the effective grain size of d_{10} (10 percent of sand is smaller). than diameter.
   3. The more silt content, the lesser the flow rate of the filter.
   4. There should be no organic matter in sand for a BSF.

5. Clay is not appropriate for the BSF technology since it slows down the flow rate.
6. Sand should not have any toxic chemicals, calcium, or salt. Therefore, rocky or quarry sand is better than river sand for BSF technology.

Parameter	Recommendation
Maximum flow rate	0.4 $m^3/m^2/hr$ (400 ml/min)
Maximum Grain Size (dmax)	0.7 mm
Effective size (d10)	0.15–0.2 mm
Uniformity Coefficient (UC) (d60 / d10)	1.5–2.5
Silt content (d < 0.1 mm)	< 4%
Sand depth	> 50 cm (54.5 cm)

II. Sand preparation involves the following steps:
   1. Filter through 0.7 mm sieve
   2. Wash (at least 3–4 times)
   3. Jar and flow test
   4. Proper storage

The group was curious to know if treated water should be used for washing the sand: since a large volume of water is required for this, such high volumes of treated water cannot to be made available in intervention areas, so source water is used. The group also discussed the market viability of the prepared sand; they considered it to be a good venture with its own set of challenges.

Dr. Atul Maldhure from the National Environmental Engineering Institute (NEERI), Nagpur, gave a brief about the organization and talked about water treatment technologies for treating turbidity, microorganisms, fluoride, iron removal, arsenic and membrane filtration, along with various methods and technologies that are available, and about those developed by NEERI. He said that NEERI ZAR and TERRAFIL are useful for the removal of microbes and turbidity, based on oxidation and mechanical filtration, and Pot Chlorinator is useful for chlorine dosing, de-fluoridation through nalgonda and electrolysis and iron and arsenic removal interventions. Participants appreciated the electro de-fluoridation technology, developed by NEERI. In a brief Q&A session following the presentation, Dr. Maldhure explained the probable modes of collaborating with NEERI, especially in the development sector.

Two case studies followed highlighting the successful implementation of HWTS. Mr. Lalit Mohan Sharma presented the case of *Jalkalp*, the biosand filter developed at Sehgal Foundation as an innovative model based on the conventional biosand filter developed by CAWST. Mr. Sharma, while explaining the filter's journey, from a precast cement concrete model to that of stainless steel one, discussed the challenges faced during the adoption of the filter and the solutions developed. Major challenges included lack of awareness amongst villagers pertaining to bacterial contamination of water, and various logistical hurdles. Mr. Sharma described different ways his team sensitised the local population: group discussions, follow-up workshops, working with self-help groups (SHGs), testing the water from different sources in community meetings, presenting tangible results about treating iron-contamination and turbidity, and providing three-month monitoring and handholding for new users. While narrating the success story, Mr. Sharma pointed out to how households with reverse osmosis purifiers were also opting for *Jalkalp*. When asked about making the filter more affordable for end users, he said his team was already working on this and cost reduction would be possible to some extent.

Mr. Arijit Karmakar, community health coordinator, BSF Project, Assembly of God Church Mission (Kolkata), talked about the organization's solution for HWTS: a cement concrete precast biosand filter. He explained how they overcame hurdles in the expansion of the filter's scope. For traceability, serial numbers are attached to the filters; pre-use surveys along with regular follow-up surveys are conducted; people, including convicts, are given training in making the filters; and, along with sensitizing villagers about the problem and the filter, training on health and hygiene-related matters is provided. Mr. Karmakar noted logistics, transportation, unavailability of local vendors, and Good and Services Tax implementation as major challenges faced by the organization.

Other participants were encouraged to share their experiences and contributions pertaining to the implementation of HWTS in their geographies. CAWST representatives shared some examples from other countries (including Honduras and Haiti) while discussing pros and cons of ceramic-based biosand filters.

In the context of higher prices of current biosand filters used, it was agreed that there is a need to sensitize the rural population about the importance of spending on preventive rather than curative measures.

Day 3

(December 1, 2017)

The third day started with the exhibition of household water treatment and related technologies; twenty-two technologies in practice from across the globe were displayed with live demonstrations. Participants rated and discussed the different technologies and their suitability for their respective geographies.

Delegates shared their feedback on the conference thus far. Dr. Candice Young-Rojanschi, CAWST, and Mr. Suneel Rajavaram, CAWST, explained the significance and methods of monitoring and evaluating HWTS along with ways to measure the impact of such an intervention. A case study followed on DACAAR, an NGO having a similar work sphere in Afghanistan. CAWST representatives carried out an exercise asking the audience to devise some indicators they think could measure the impact of their interventions or development programs.

Following this was a presentation on maintaining quality and a discussion pertaining to conducting quality checks on biosand filters. The group discussed and decided to form a HWTS network in India to enable knowledge and experience sharing among stakeholders (research organizations, NGOs, multilateral organizations and others). The scope of such a network would include organizing regular discussions on scaling up of adoption, innovation, and promotion of household water treatment technologies like biosand filters, and serve as a capacity-building and networking platform. The session ended with technical experts demonstrating a *Jar-test* and *flow-test* and deliberated about their efficiency.

Issues discussed included scaling up and commercialization of biosand filters, maintaining quality and cleanliness within filters, different efforts pertaining to making filters more appealing to the end users (including beautification), probable designs and dimension alterations to increase the capacity and improve the efficiency of these filters, and expanding the scope of filters in order to address other contaminants.

On the scaling up issue, the group suggested encouraging deeper involvement of SHGs and adoption of revolving funds amongst communities. Various examples showed that encouraging women's participation would contribute significantly toward boosting adoption of such filters. Sehgal Foundation's recharge well design also drew much attention.

Action points

Participants drafted an action plan to carry forward the momentum achieved throughout the conference and agreed upon the following agenda:

- Constitute a countrywide HWTS network in India.

  Sehgal Foundation will coordinate organization of such a network; two annual events will be organized as the initial step. CAWST agreed to be the technical partner for this initiative.

  - Convene a meeting exclusively for networking purposes with relevant stakeholders.
  - Conduct a training workshop for NGOs.

- Water testing training, scaling up adoption of biosand filters, and enhancing women's participation were finalized as major themes for subsequent workshops.
- Future discussions will be directed toward efforts for developing a community-based biosand filter.

The conference ended with Mr. Sharma presenting a vote of thanks.